## *Teaching Activity: Air Trapped in Ice*

***Introduction:*** The ice of Antarctica and elsewhere around the globe is a repository of change over a very long period in Earth's history. The source of this ice is the snow that falls each year on a glacier or ice cap, thaws in the Sun, recrystallizes and subsequently consolidates. As it freezes, bubbles of gas from the air are trapped in the ice. If those bubbles are recovered, extracted and analyzed, they provide samples of ancient air. With the realization that this rich record exists, scientists began drilling into glaciers and ice caps, braving the elements to bring samples to refrigerated laboratories that reveal the chemical composition and climatic condition of the past. One of the longest continuous records of the ancient atmosphere comes from an ice core drilled by a team of French-Russian scientists on the Antarctic ice sheet; its data span is 160,000 years. These core samples are housed in the National Ice Core Laboratory in Denver, CO.

***Objective:***

- To observe air bubbles trapped in ice cubes and compare them to air trapped in glacial ice;

***Important Terms:*** Glacier, glacial ice, air bubbles, atmosphere, fossil air, phase change, melt, freeze;

***Materials:*** Ice cubes, plastic lid, container of hot water, liquid dish detergent, hand lens, paper/pencil, **Student Activity Sheet.**

***Procedure:***

1. Pass out **Student Activity Sheets** and read over and discuss the **Introduction** with the class.
2. Make an overhead or a large drawing of the lab setup and discuss it with the class.
3. Assign students to groups of 2-4 and supply each group with the required materials.
4. Instruct students to observe the ice cube with a hand lens and note the quantity and location of air bubbles trapped in the ice in **PART I: OBSERVATIONS** of their activity sheet.
   - This may be done as a drawing or in a written format.
5. Lead a discuss about how the bubbles may have become part of the ice cube.
   - Record these ideas on chart paper or the black board.
6. Have students add a drop of detergent to the ice cube as its sits on the plastic lid above the container of hot water.
   - The ice cube will begin to melt, releasing the bubbles into the air.

7. Instruct students to observe the ice cube with the hand lens as it melts.
    - Air bubbles will be released from the ice cube and become trapped in the soap.

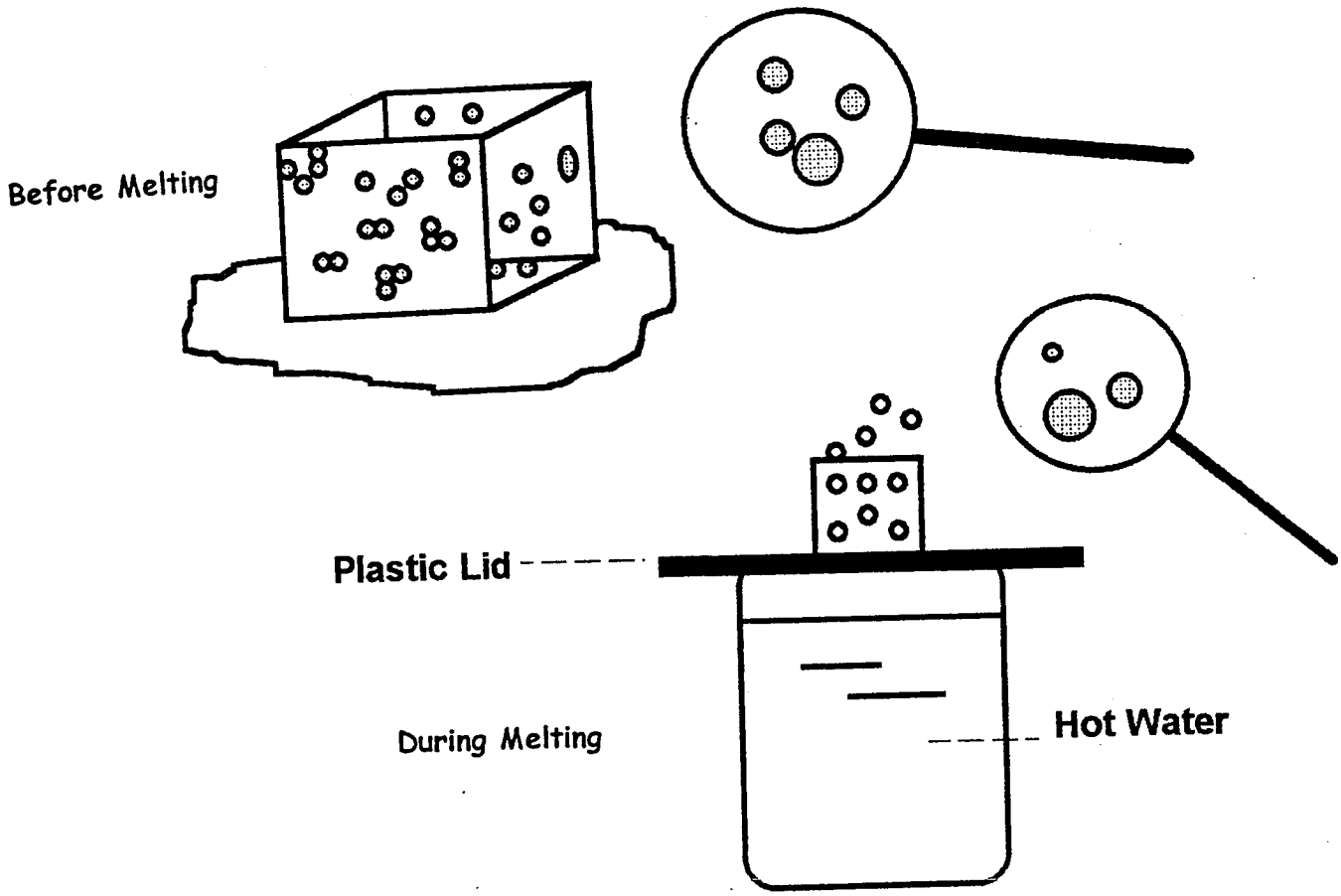
8. Students should be taking notes and drawing their observations.

9. Lead a discussion with the class about what they saw happen.
    - Record their answers on chart paper or the blackboard.

10. Challenge students to develop a way to "capture" the day old air so it cannot become contaminated by the air in the classroom.
    - Their ideas should be included in **PART II: APPLICATION.**
    - Draw parallels with the fossil air trapped in glacial ice.

11. Instruct students to answer the questions in **PART III: ANALYSIS/COMPREHENSION.**

**DIAGRAM OF LAB SET-UP:**



## *Student Activity Sheet: Air Trapped in Ice*

***Introduction:*** The ice of Antarctica and elsewhere around the globe is a repository of change over a very long period in Earth's history. The source of this ice is the snow that falls each year on a glacier or ice cap, thaws in the Sun, recrystallizes and subsequently consolidates. As it freezes, bubbles of gas from the air are trapped in the ice. If those bubbles are recovered, extracted and analyzed, they provide samples of ancient air. With the realization that this rich record exists, scientists began drilling into glaciers and ice caps, braving the elements to bring samples to refrigerated laboratories that reveal the chemical composition and climatic condition of the past. One of the longest continuous records of the ancient atmosphere comes from an ice core drilled by a team of French-Russian scientists on the Antarctic ice sheet; its data span is 160,000 years. These core samples are housed in the National Ice Core Laboratory in Denver, CO.

***Objective:***

- To observe air bubbles trapped in ice cubes and compare them to air trapped in glacial ice;

***Procedure:***

1. Read over and discuss the **Introduction** with your teacher.

2. Get into groups of 2-4 and pick up the required materials.

4. Observe the ice cube with a hand lens and note the quantity and location of air bubbles trapped in the ice in **PART I: OBSERVATIONS** of your activity sheet.
   - This may be done as a drawing or in a written format.

5 . Add a drop of detergent to the ice cube as its sits on the plastic lid above the container of hot water.

6. Observe the ice cube with the hand lens as it melts.

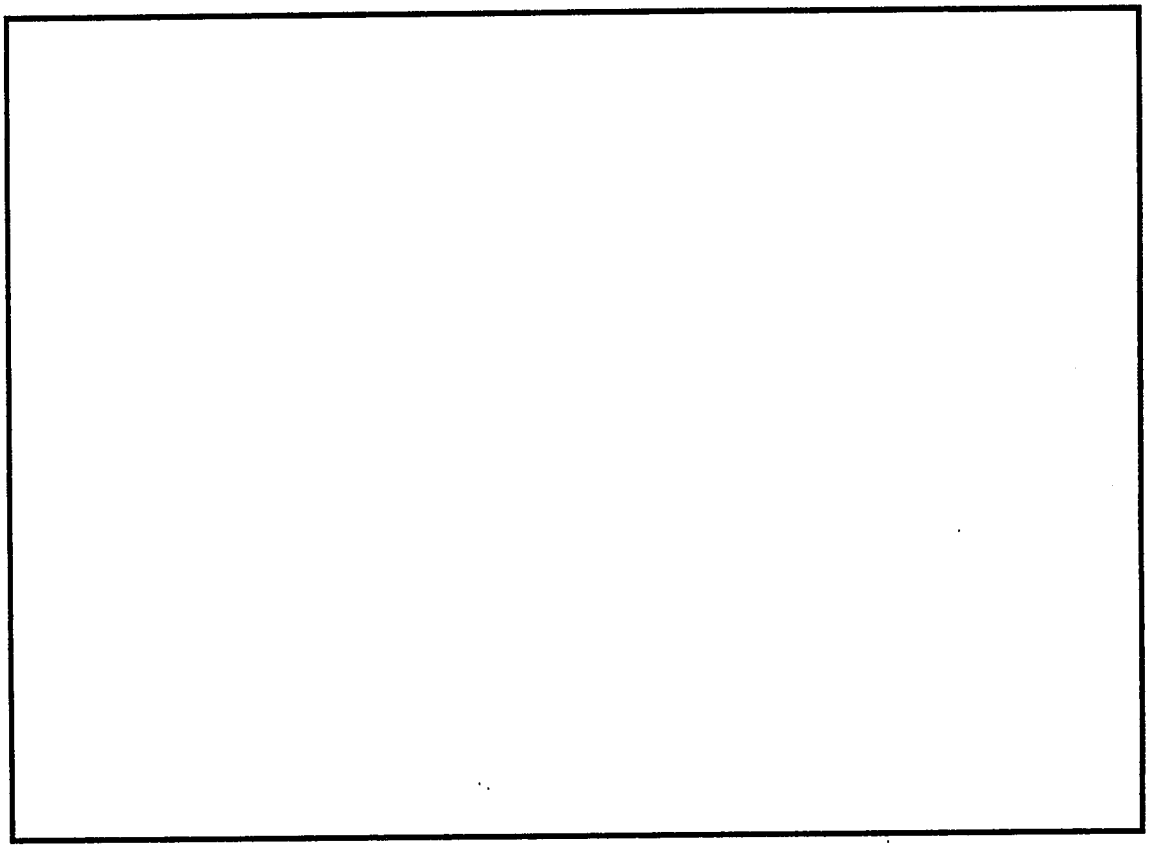
7. Students take notes and draw your observations.

8. Develop a way to "capture" the day old air so it cannot become contaminated by the air in the classroom.
   - Include your ideas in **PART II: APPLICATION.**

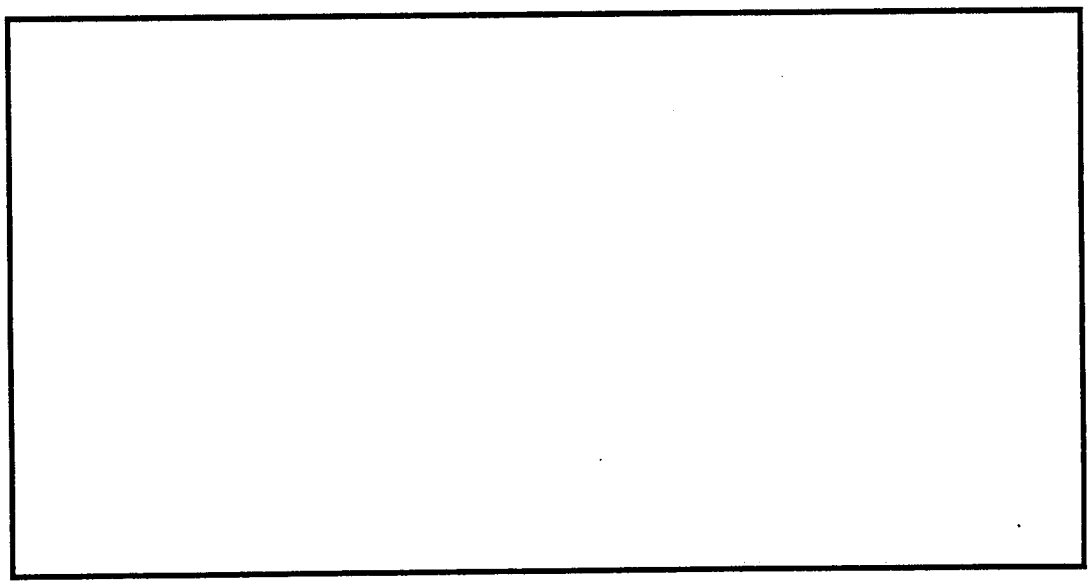
11. Answer the questions in **PART III: ANALYSIS/COMPREHENSION.**

*Student Activity Sheet #1: Air Trapped in Ice*

PART I: OBSERVATIONS



PART III: APPLICATION



Student Activity Sheet # 1

## PART III: ANALYSIS / COMPREHENSION

1. What did you see when you looked at the ice cube with the hand lens?

2. What happened when you placed the ice cube over the hot water?

3. What did you observe happening to the air bubble as the ice cube melted?

4. How do you think the air bubble got into the ice cube? _____

5. How does the air trapped in the ice cube compare to the air trapped in the ice of a glacier? _____

6. How might air trapped in an ice cube be "captured" so that it doesn't mix with fresh air? _____

7. How would the age of the air from the ice cube compare to the age of the air trapped in a glacier? _____